(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 299 742 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88306415.6

(22) Date of filing: 13.07.88

(51) Int. Cl.4: G 11 B 20/12
G 11 B 7/007, G 11 B 7/013

(30) Priority: 15.07.87 JP 176173/87
24.03.88 JP 70062/88

(43) Date of publication of application:
18.01.89 Bulletin 89/03

(84) Designated Contracting States: DE FR GB

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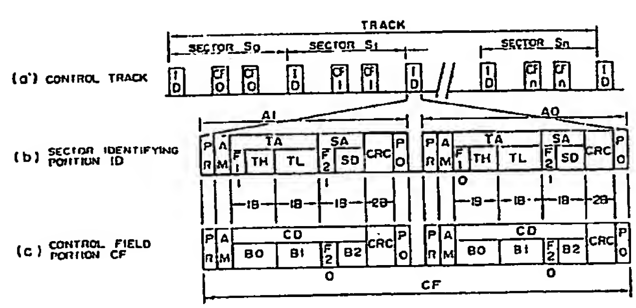
(54) Optical disk.

(57) The present invention relates to an optical disk (1) having a control track. The control track is divided into sectors in a manner similarly to a data track to record data and comprises a plurality of sectors. Each sector is composed of a sector identifying portion ID in which address information is recorded and a control field portion CF in which control data is recorded. The control field portion CF has the same format as the sector identifying portion ID. The control data is divided into recording data units in the control field and recorded. An identification flag is provided for each of the sector identifying portion ID and control field portion CF. The control track is searched by the address information in the sector identifying portion ID. The address data and control data are selected by use of the identification flags in the sector identifying portion ID and control field portion CF, and they are read, then the control data are reassembled in order by using the address data of the sector identifying portion ID.

FIG. I



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Description

OPTICAL DISK

BACKGROUND OF THE INVENTION

As control identification information of a conventional optical disk, a method of recording a control track onto a part of the optical disk has been known as disclosed in, e.g., ISO (International Standard Organization) Draft Proposal ISO/DP 9171-2 (5th DP), 1.7.2 Phase encoded part (PEP).

Fig. 5 shows a format of the control track in the conventional example. As shown in Fig. 5(a) data is repetitively recorded three times on one track. As shown in Fig. 5(b), each data comprises: data of 144 bits; a sector address of 8 bits; an error detection code (CRC) of 8 bits; a preamble (PR) of 16 bits to regenerate a clock; and a synchronization bit (SYNC) of 1 bit indicative of the head of the data. Each data bit is PE (Phase Encoding) modulated as shown in Fig. 5(c), by an enough low frequency and recorded onto hundreds of tracks so as to be read at various rotational speeds.

When the optical disk is inserted into a drive, a head is moved by a linear motor and the control track is accessed, so that the control data is read out and various kinds of information which are peculiar to the disk such as recording system, recording and reproducing conditions, recording area, and the like are known. On the basis of these disk information, the operating mode of the drive is set. Due to this, various kinds of optical disks can be used by a single drive.

According to the foregoing structure, since no track address information is recorded on the control track, the control track cannot be directly sought. Therefore, the head is once moved to a position near the control track and either some of the hundreds of control tracks are roughly read without performing the tracking control. This causes the recording capacity of the disk to be reduced and the precise mechanism to accurately seek the control track is needed for the drive. In addition, since the optical head is moved to the control track portion without using any track address, the moving speed cannot be raised. Further, the waiting time of the rotation of the disk in the rough reading operation to seek the control track is caused. Therefore, when the disk is exchanged by the drive, it takes a time to read the control data from the control track and there is a problem such that the rise-up speed of the drive becomes slow.

SUMMARY OF THE INVENTION

In consideration of the foregoing points, it is an object of the invention to provide an optical disk in which control data of various kinds of optical disks can be promptly detected with a high reliability. Particularly, it is an object of the invention to provide an optical disk in which control data is promptly read by searching a control track at a high speed without using any additional mechanism and/or circuit, a driving apparatus can be actuated at a high speed, and a high extending capability of the apparatus can be obtained.

The control track of the optical disk according to the invention is divided into sectors in a manner similar to the data track to record data and comprises a plurality of sectors each including sector identifying portion ID in which address data is recorded and a control field portion CF in which control data is recorded. The control field portion CF has the same format as that of the sector identifying portion ID. The control data is divided into recording information units in the control field portion CF. Identification flags are respectively added to the sector identifying portion ID and control field portion CF and these portions are recorded onto a plurality of tracks. Similarly to the data track, the control track is sought by the address information in the sector identifying portion ID. The control data is selected by using the identification flags in the sector identifying portion ID and control field portion CF and it is read.

According to the present invention, the rise-up time of the driving apparatus can be remarkably reduced due to the reproduction of the control data with a high reliability and the high speed search of the control track, so that its practical effect is large.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an arrangement diagram of a format of a control track on an optical disk in an embodiment of the present invention;

Fig. 2 is an arrangement diagram of identification flags and a track format;

Fig. 3 is a sector arrangement diagram of control tracks on an optical disk in the second embodiment of the invention;

Fig. 4 is a block diagram of an embodiment of a drive to read address information and control data in a sector identifying portion from the optical disk of the invention; and

Fig. 5 is an arrangement diagram of a format of a control track in a conventional example.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is an arrangement diagram of a format of a control track on an optical disk in an embodiment of the present invention. The control track shown in Fig.1, (a), comprises a sector identifying portion (ID) and a control field portion (CF) in which control data (CD) is recorded. Sectors S_0, S_1, ..., S_n respectively have the control field portions CF_1 to CF_n each of which was written twice. The sector identifying portion ID comprises addresses A_0 and A_1 which were written twice as shown in Fig. 2(a). These addresses are distinguished by 0/1 of an address identification flag (F_2) provided for the most significant bit of the higher byte TH of a track address (TA). Each of the addresses A_0 and A_1 comprises: a

preamble (PR) to regenerate a clock; an address mark (AM) indicative of the head of data; address information (TA, SA); an error detection code (CRC); and a postamble (PO) to regenerate a clock.

F_1 denotes a flag to indicate the address A_0 or A_1.

The address information comprises the track address TA: a higher track address (TH) and a lower address (TL), and a sector address (SA). The sector address SA comprises sector address data (SD) and a CD/ID identification flag F_2. The flag F_2 is set to, for example, 0.

Fig.1(c), shows a format of the control field portion CF. The fundamental structure of the control field portion CF is the same as that of the sector identifying portion ID and the address information corresponds to the control data. Namely, TA corresponds to bytes B_0 and B_1 and SD in SA corresponds to byte B_2. In the control field portion CF, the CD/ID identification flag F_2 is set to 1 which is opposite to the case of the sector identifying portion ID and is distinguished therefrom.

As mentioned above, if the control track is formatted in the same manner as the data track, the sector format of each control track becomes the same as the data track. Since the sector identifying portion ID of the control track is also read by a data track seeking circuit, the control track can be also sought in the same manner as the data track.

Further, if the control field portion CF is formatted in the same manner as the track format of the sector identifying portion ID, a sector identifying portion reproducing circuit can be commonly used to read the control data.

Fig. 2 is an arrangement diagram of an embodiment of a track format on an optical disk of the invention. (a) in Fig. 2 shows an embodiment of the control track shown in Fig. 1(a). $F_2 = 1$ in the sector identifying portion ID. $F_2 = 0$ in the control field portion CF. The sector identifying portion ID and control field portion CF which are formatted in the same manner are recorded on the control track. Therefore, the driving apparatus can distinguish whether the readout data is the track address information or the control data by checking to see if the flag F_2 of the sector identifying portion ID and control field portion CF which were read out is set to "1" or "0".

Fig. 2(b) shows a format of a data track onto which data can be recorded. In this data track, since F_2 of the sector identifying portion ID is set to 0, it can be known that the relevant sector is the data track. Therefore, this data track can be distinguished from the control track (F_2 of the sector identifying portion is set to 1). An error correction code is added to the user's data and then this user's data is recorded into the data field portion (DF). On the other hand, as shown in Fig. 2(c), if it is constituted in a manner such that by setting F_2 of the sector identifying portion ID to 1 in the case of the read only data track, the data field portion DF indicates the read only area, the erroneous recording of data to the data field portion DF in the read only area can be prevented. Further, the switching and adjusting control of the gain of the focus servo or the like can be performed by detecting the difference between the reflectance of the signal track which was recorded as pits in the read only area on the optical disk and the reflectance of the continuous groove track onto which data is recorded. The system can be further stabilized.

The control data of three bytes in each of the control field portions CF_0, CF_1, ..., CF_n in Fig. 2(a), is arranged in a manner such that the CF_0 is recorded in the sector 0, the CF_1 is recorded in the sector 1, the CF_2 is recorded in the sector 2, ..., and the CF_n is recorded in the sector n in correspondence to the sector addresses SA in the sector identifying portion ID. The control data of total $3 \times (n+1)$ bytes can be recorded.

On the other hand, for instance, assuming that 32 sectors are provided for each track, the CF_0 to CF_{15} are recorded into the sectors 0 to 15 in the semicircle and the control data same as in the sectors 0 to 15 are repetitively recorded into the sectors 16 to 31 in the remaining half circle in a manner similar to the CF_0 to CF_{15}. In this manner, the control data of $3 \times 16 = 48$ bytes can be recorded by being interleaved among the sectors. Moreover, the control data which is strong to defects of the disk and has a high reliability can be reproduced.

Fig. 3 is a sector arrangement diagram of control tracks on an optical disk in the second embodiment of the invention. The control tracks comprise m tracks of track addresses 1 to m and each track has n sectors. Each sector comprises the sector identifying portion ID in which the address information TA and SA were recorded and the control field portions CF_1, CF_2, CF_3, ..., CF_m corresponding to the data field portion DF in the data recording sector.

The control field portion CF is constituted by the same format as that of the sector identifying portion ID. The control data divided on a 3-byte unit basis of the addresses in the sector identifying portion ID is recorded in the control field portion CF. The control data of the same three bytes are recorded in all of the sectors on the track of the same address in a manner such that the control field portion CF_1 is recorded onto the track 1, the control field portion CF_2 is recorded onto the track 2, ..., and the control field portion CF_m is recorded onto the track m. All of the control data are recorded onto the m tracks while the 3-byte data are updated by the track addresses. That is, the control data is recorded into the sectors in a form such that it is divided into the control data of three bytes every control track. (Namely, the CF_1 is recorded into the sectors 1 to n on the track 1, the CF_2 is recorded into the sectors 1 to n on the track 2, ..., and the CF_m is recorded into the sectors 1 to n on the track m). For example, if fifteen control tracks are used, the control data capacity is set to 45 bytes (= 3 bytes X 15). As explained above, the control data are interleaved among the tracks and at the same time, the control data of the same three bytes are recorded in the sectors on each track. Therefore, the control data which are strong to defects of the optical disk and has a high reliability can be read out.

When reading out of the control tracks, the head control track is first sought and the control field portion CF is read out in accordance with the order

of CF_1, CF_2, CF_3, ..., CF_m from the control field portion in either one of the sectors 1, 2, ..., n from the head control track, then, the adjacent track is sought. In accordance with this procedure, the control tracks can be sequentially read out.

Since the same control data unit is recorded in all of the sectors of each track, if the control field portion CF is read, the optical head can be soon jumped to the next track and can access it. This is because, there is no sequence among the sectors of the control track, and the same control data unit is recorded in all of the sectors.

Consequently, there is no need to wait for the rotation of the optical disk. The control data can be successively read out every other sectors in such a manner that, for instance, the CF_1 in the sector S_1 is read out the track jump in the sector S_2 the CF_2 is read out in the sector S_3 the track jump in the sector S_4 ...

On the other hand, if either one of the n sectors is read out, the control data can be read out, so that the yield of the optical disk is good.

As described above, this embodiment is characterized in that for the control tracks, the same data is recorded in all of the sectors of one track; so that a fairly high reliability is obtained and the reading speed of the control data is higher.

In the first and second embodiments mentioned above, the CD/ID identification flag F_2 has been provided in the sector address SA. However, the flag F_2 can be also obviously provided for the idle bit in the track address in the case where eight bits are necessary for the sector address when the number of sectors is set to 128 or more in an optical disk of the MCAV (Modified Constant Linear Velocity) type in which the rotational speed of the optical disk is constant and which is formatted to a track group whose number of sectors per track is increased by a few sectors at a time from the inner rim to the outer rim of the disk, an optical disk having a large diameter, or the like.

If a frequency modulation (FM), PE (Phase Encoding) modulation, or the like in which clock bits are certainly included in the input data bits is used as a modulating system of the sector identifying portion ID, a regenerative clock for signal demodulation is directly obtained from the reproduction signal, so that the PLL (Phase Locked Loop) or the like does not need to be used. Therefore, even if the rotational speed of the disk varies in a wide range, data can be preferably reproduced. When comparing with the (2, 7) RLLC (Run Length Limited Code) modulation which is frequently used for the data field portion DF, the data recording density in the PE modulation is 1/3, so that the PE modulation is characterized in that the bit error rate is better by the amount of this small data recording density, the detection window is larger, data can be accurately reproduced at a data speed within a wide range by a small scale circuit.

Fig. 4 is a block diagram of a drive to read the address information in the sector identifying portion ID and the control data CD from an optical disk 1 according to the invention. The data recording and reproducing section and the servo system are omitted in the diagram. Reference numeral 1 denotes the optical disk; 2 is a motor M; 3 an optical head to record or read out data onto and from the optical disk 1; 4 a sector identifying portion reproducing circuit to read out address information of tracks and sectors from the sector identifying portion ID; 5 and 6 AND circuits; 7 a seeking circuit for performing seeking control to move the optical head 3 at a high speed by a linear motor and to seek a predetermined track on the optical disk 1; and 8 an inverter.

In the diagram, the drive applies to the seeking circuit 7 the address information of the control track to be sought as a target track address signal 9. The seeking circuit 7 compares an address signal 10 read by the sector identifying portion reproducing circuit 4 with the target address signal 9 and accesses the optical head 3 to an object track at a high speed.

A reproduction signal 11 of the optical head 3 is demodulated by the reproducing circuit 4 and a demodulation signal 12 is output. When the optical head 3 reads out the sector identifying portion ID, the demodulation signal 12 indicates the track address information (track address TA and sector address SA). On the other hand, when the optical head 3 reads out the control field portion CF, the demodulation signal 12 represents the control data CD.

The demodulation signal 12 is divided into an address signal 10 and a control data signal 14 by the AND circuits 5 and 6 on the basis of the sector address data SD and a flag F_2 signal 13 as the most significant bit of the control data byte B_2. That is, when the identification flag F_2 signal 13 is set to "1", the AND circuit 5 is made effective, so that the address signal 10 is output. When it is set to "0", the signal 13 is inverted by the inverter 8 and the AND circuit 6 is made effective, so that the control data signal 14 is output.

If the clock of the PE modulation or the like is provided for each bit of the sector identifying portion ID, the sector identifying portion reproducing circuit 4 can directly regenerate clocks from the reproduction signal 11 without using the PLL circuit as mentioned above. Even if the rotational speed of the disk changes in a wide range, clocks can be preferably regenerated as compared with the case of regenerating clocks by the PLL circuit.

Therefore, the control track on the optical disk of the invention can be easily read by various kinds of driving apparatuses.

As will be obviously understood from the above description, the control track can be freely sought in the same manner as the data track by setting the control track so as to have the same sector format as that of the data track. Further, by setting the control field portion to the same format as that of the sector identifying portion, the sector identifying portion reproducing circuit can be commonly used to read the control data. In addition, when using the modulating system such that the modulation data bit has the clock bit, the address of the control track can be accurately read by various kinds of driving apparatuses and the control track can be directly

sought. Thus, the control data can be promptly detected and the rise-up time of the drive when the disk is exchanged can be fairly reduced. On the other hand, since an enough reliability is derived even when using the control tracks of the number within a range from a few tracks to a ten and a few tracks, the reduction of the recording capacity is small.

As described above, according to the invention, a position seeking mechanism and a reading circuit of a special control track are unnecessary and the control data can be reproduced with a high reliability. Moreover, the rise-up time of the drive upon exchange of the disk can be remarkably reduced by directly seeking the control track and the like. As mentioned above, practical effects of the invention are large.

Claims

1. An optical disk having a control track on which control data of the optical disk (1) is recorded, wherein each sector of said control track includes a sector identifying portion ID in which address information is recorded and a control field portion CF in which the control data of the optical disk (1) is recorded, the sector identifying portion ID and control field portion CF of said control track have the same format as that of the sector identifying portion ID of the data track to record data, identification flags are provided for the sector identifying portion ID and control field portion CF which constitute the sector of the control track, and the control data and sector address information are discriminated by said identification flags.

2. An optical disk according to Claim 1, wherein said control field portion CF is included in each of a plurality of control tracks in which data CD_0, CD_1, CD_2, ..., CD_n which are derived by dividing the control data into data units which can be recorded to the respective control field portion CF are recorded corresponding to sectors S_0, S_1 S_2, ..., S_n of the same track in correspondence to each sector unit in a manner such that the data CD_0 is recorded to the sector S_0, the CD_1 is to the S_1, the CD_2 is to S_2, ..., and the CD_n is to S_n.

3. An optical disk according to Claim 1, wherein in the control field portion CF recorded on the control tracks T_0, T_1, T_2, ..., T_n, the control data is divided into data units CD_0, CD_1, C_2, ..., CD_n which can be recorded to the control field portion CF, said data units are recorded to all of the sectors of one track in correspondence to the track addresses of the control tracks in a manner such that the data unit CD_0 is recorded into all of the sectors of the control track T_0, the CD_1 is to all sectors of the T_1, the CD_2 is to all sectors of the T_2, ..., the CD_n is to all sectors of the T_n, and said data units are recorded as the control data onto a plurality of tracks.

4. An optical disk according to any one of Claims 1 to 3, wherein said identification flags are provided for idle bits of either track address information or sector address information of the sector identifying portion ID.

5. An optical disk according to Claim 1, wherein said sector identifying portion ID is recorded by a modulating system in which all of the data bits have clocks.

FIG.1

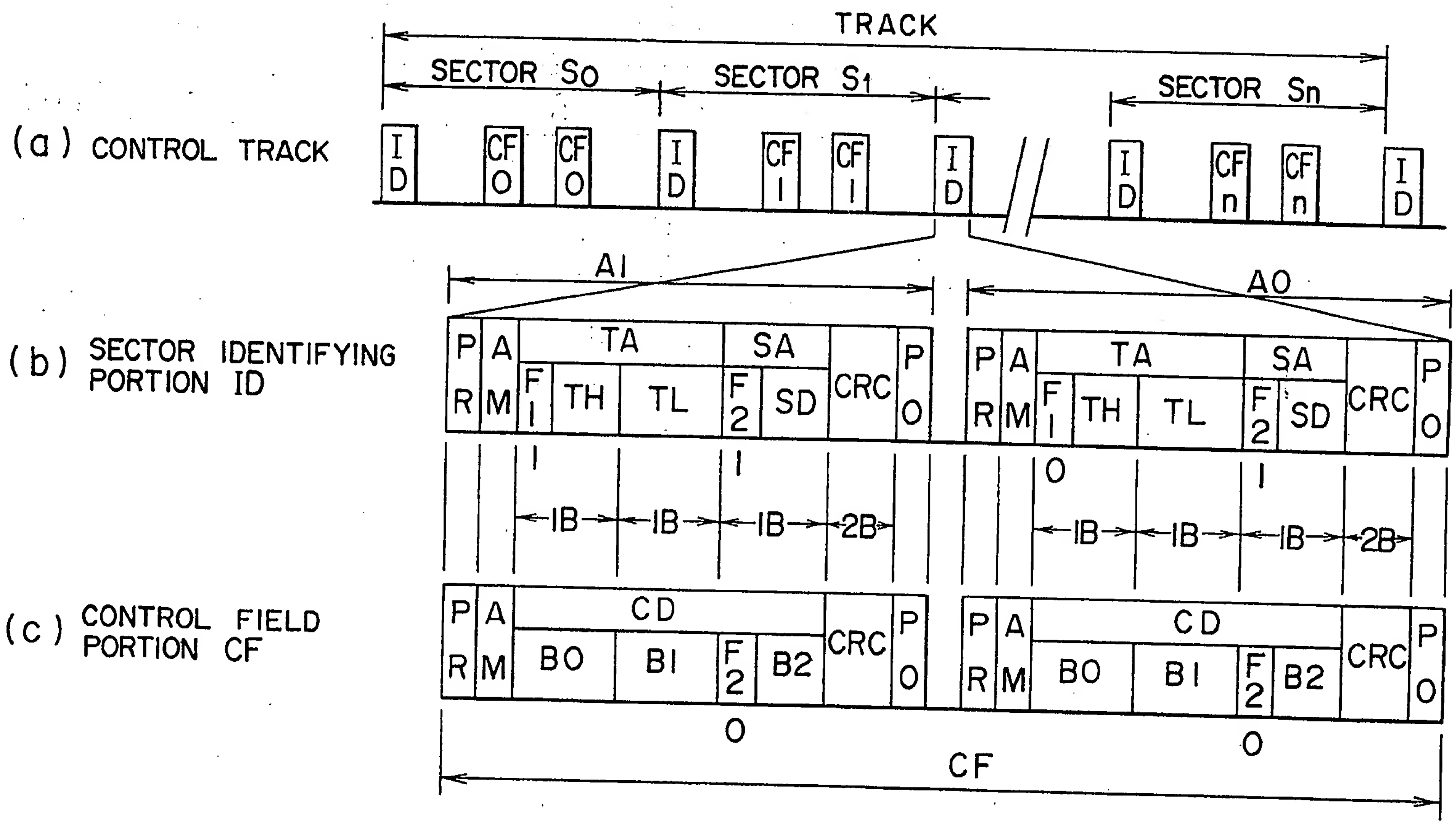

TRACK
SECTOR S0
SECTOR S1
SECTOR Sn
(a) CONTROL TRACK
ID
CF 0
CF 1
CF n
AI
AO
(b) SECTOR IDENTIFYING PORTION ID
PR
AM
TA
SA
F1
TH
TL
F2
SD
CRC
PO
IB
2B
(c) CONTROL FIELD PORTION CF
CD
BO
BI
B2
CF

FIG. 2

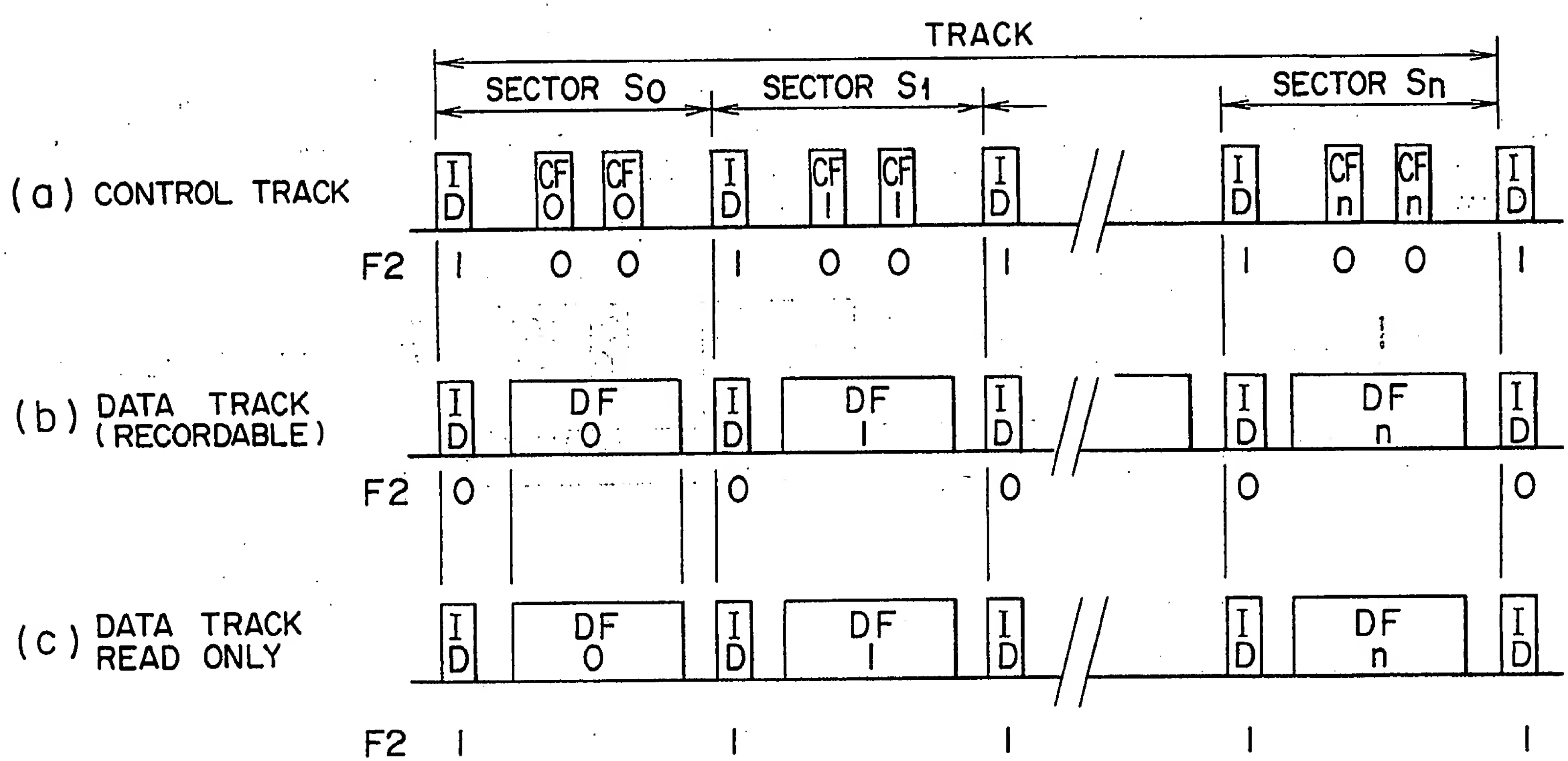

TRACK
SECTOR S0
SECTOR S1
SECTOR Sn
(a) CONTROL TRACK
(b) DATA TRACK (RECORDABLE)
(c) DATA TRACK READ ONLY
ID
CF 0
CF 1
CF n
DF 0
DF 1
DF n
F2
1
0

FIG. 3

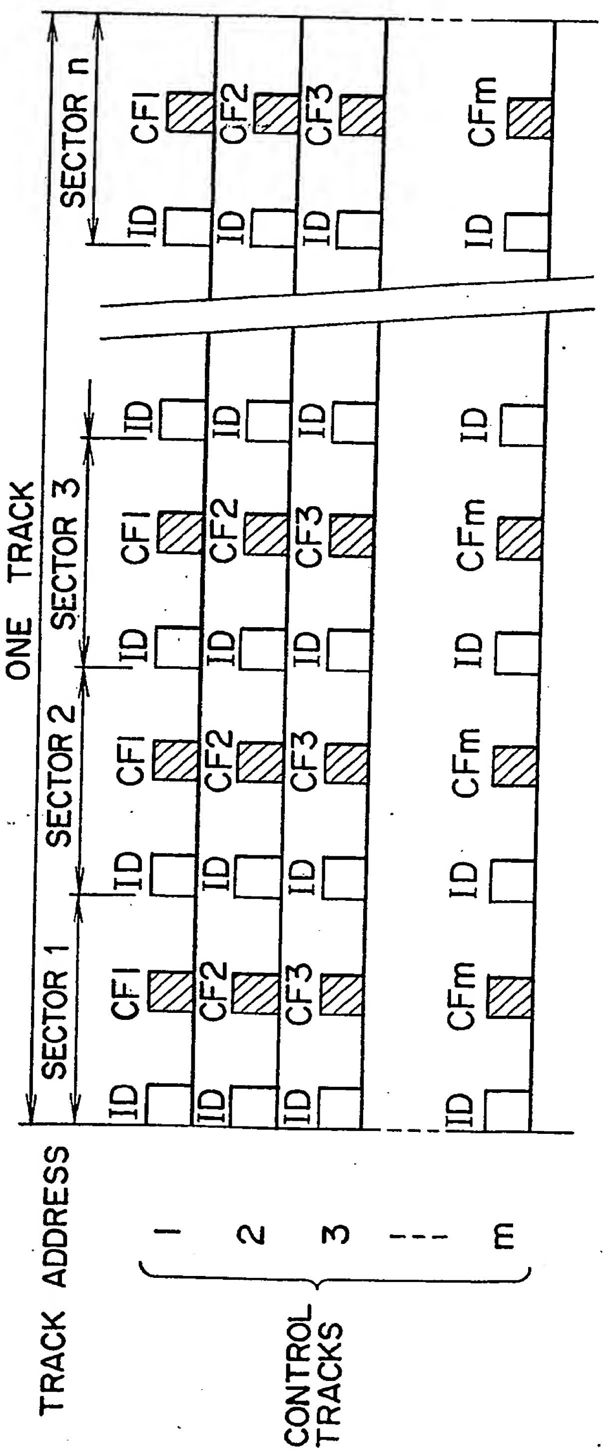

ONE TRACK
SECTOR 1
SECTOR 2
SECTOR 3
SECTOR n
TRACK ADDRESS
1
2
3
m
CONTROL TRACKS
ID
CF1
CF2
CF3
CFm

FIG. 4

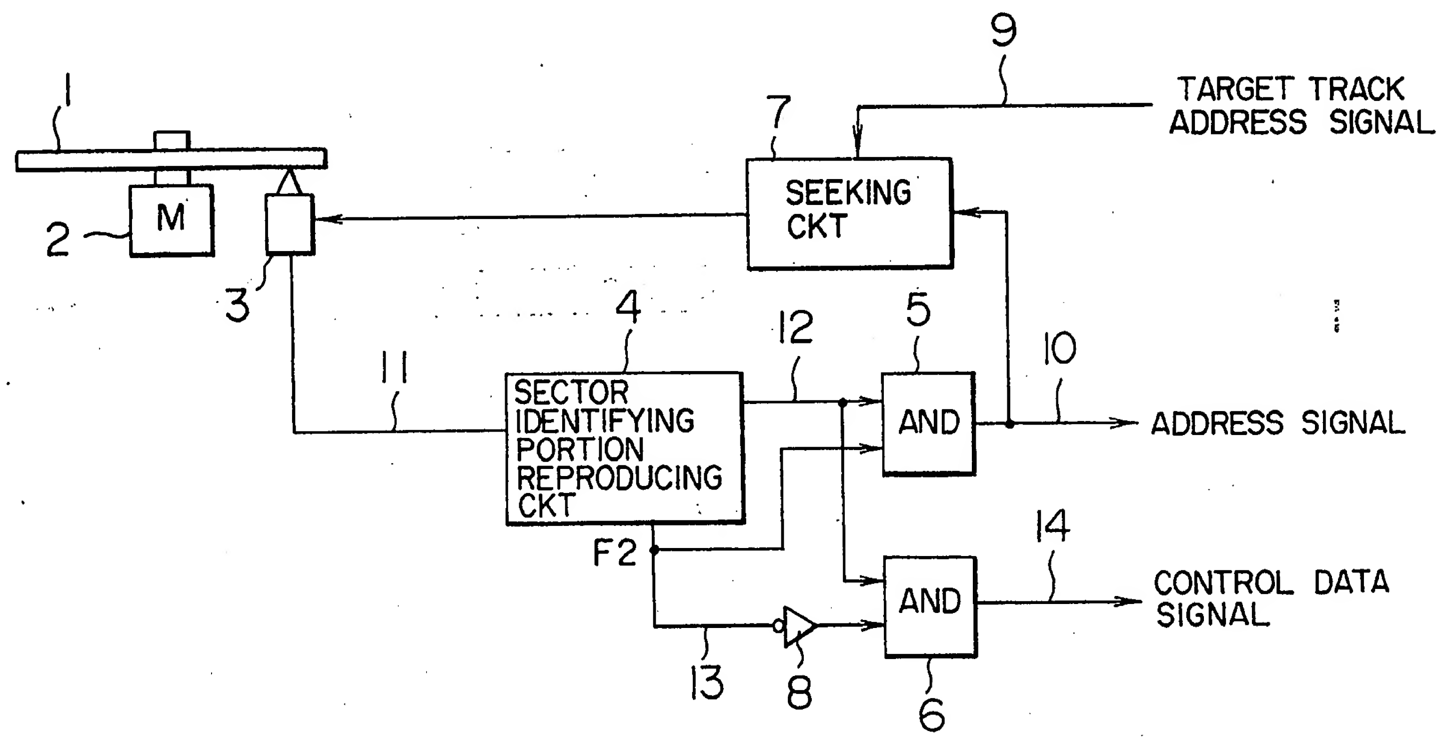
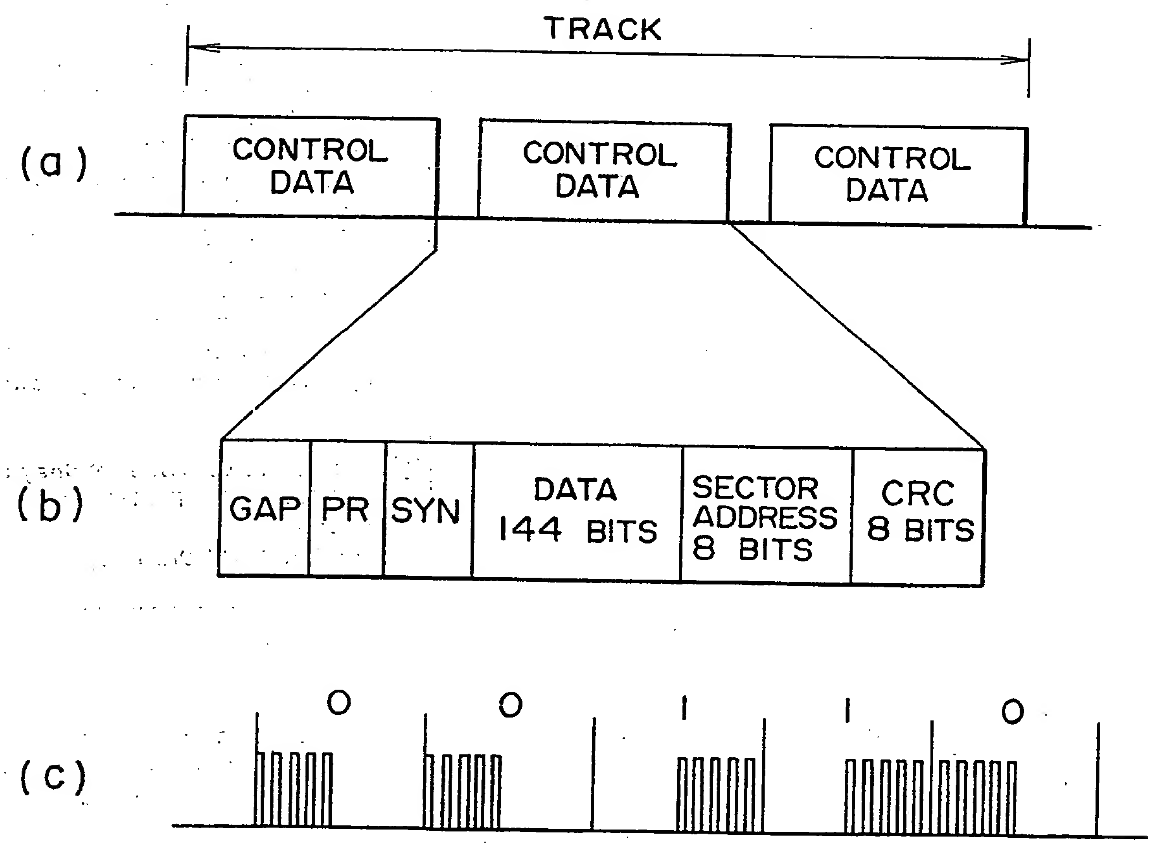

1
2
M
3
7
SEEKING CKT
9
TARGET TRACK ADDRESS SIGNAL
4
SECTOR IDENTIFYING PORTION REPRODUCING CKT
F2
11
12
13
5
AND
6
AND
8
10
ADDRESS SIGNAL
14
CONTROL DATA SIGNAL

FIG.5
PRIOR ART



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(88) Date of deferred publication of the search report:
07.03.90 Bulletin 90/10

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(54) **Optical disk.**

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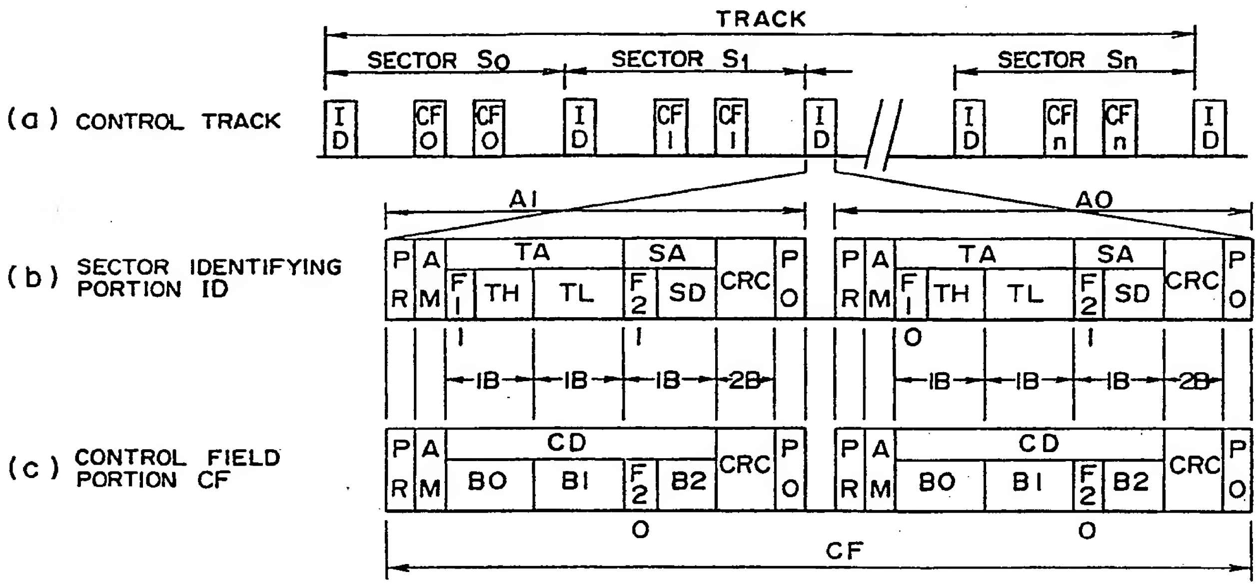
FIG. I


TRACK
SECTOR So
SECTOR S1
SECTOR Sn
(a) CONTROL TRACK
ID
CF O
CF I
CF n
AI
AO
(b) SECTOR IDENTIFYING PORTION ID
PR
AM
TA
F1
TH
TL
SA
F2
SD
CRC
PO
IB
2B
(c) CONTROL FIELD PORTION CF
CD
BO
BI
B2
CF

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 88306415.6

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	EP - A2 - 0 216 704 (FUJITSU LIMITED) * Fig. 2; column 4, line 45 - column 5, line 28 * --	1	G 11 B 20/12 G 11 B 7/007 G 11 B 7/013
A	US - A - 4 663 752 (KAKUSE et al.) * Fig. 1; column 3, lines 1-32 * --	1	
A	US - A - 4 571 716 (SZERLIP) * Fig. 4; column 6, line 21 - column 7, line 9 * ----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			G 11 B 20/00 G 11 B 7/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	15-11-1989	BERGER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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